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A SYMPOSIUM ON TRANSONIC FLOW RESEARCH. (U)
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A SYMPOSIUM ON TRANSONIC FLOW RESEARCH. (U)

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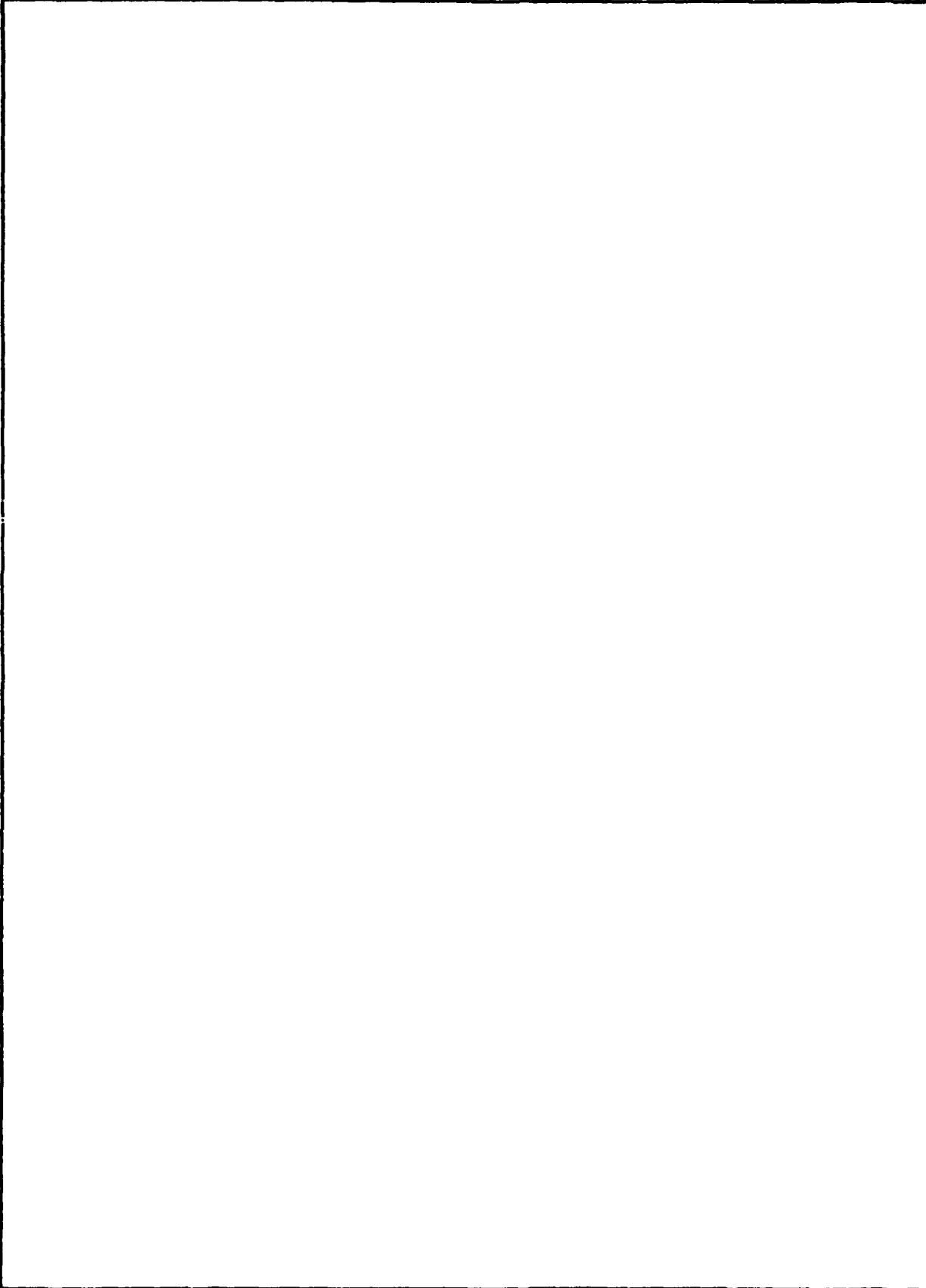
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(6) A SYMPOSIUM ON TRANSONIC FLOW RESEARCH,

by

(10) David/Nixon

(12) 22/

(9) Rept. for 21 Jul 80-21 Jul 81.

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(11) September 1981

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OFFICE OF NAVAL RESEARCH
Arlington, Virginia

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A SYMPOSIUM ON TRANSONIC FLOW RESEARCH

David Nixon
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ABSTRACT

This report documents the organization and operation of the "Transonic Perspective" conference held at NASA/Ames Research Center, February 19-20, 1981.

1. INTRODUCTION

After a period of decline in the 1960's transonic flow research has made rapid progress in the last decade. This is partly due to a renewed interest in the transonic regime for both military and civil aircraft and partly to the availability of large computers, which gave considerable impetus to the development of numerical prediction methods for realistic flows. However, not all the significant research of the decade is in the field of predictive methods; other topics such as experimental techniques for unsteady transonic flows and the supercritical wing technology, are also of importance.

Much of the work in the various sub-topics of transonic flow research is done by small groups and sometimes these groups operate in relative isolation to other work in other topics.

It is suggested, sometimes, that research workers concentrate on their own speciality so much that they consider their achievements as ends in themselves, rather than relating their results to the dominant problem of the understanding and prediction of real, practical, transonic flow problems.

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The relative isolation of some significant research is sometimes compounded by the fact that the results are published in different journals, sometimes in different languages, and read by different people. Furthermore, the significant work can be buried under the current plethora of less significant work caused by the "publish or perish" syndrome. There is a strong case to be made for separating the important from the lesser work and publishing it in one volume so that each sub-topic can be comprehensively reviewed and put in its correct context to other work.

This was the basis for organizing a symposium to review progress in solving transonic flow problems. The symposium was entitled "Transonic Perspective - A Critique of Transonic Flow Research," and was held at NASA/Ames Research Center, on February 18-20, 1981. The author served as organizer and General Chairman. The conference was supported jointly by the Office of Naval Research and the Ames Research Center. The proceedings of the conference will be published in book form. This report summarizes the planning and conference activity.

2. PUBLICITY

A preliminary announcement of the conference was mailed in September 1980 to engineers known to the author to be interested in the field and to 7390 engineers on the fluid dynamics and aircraft design section of the mailing list of the American Institute of Aeronautics and Astronautics (AIAA). A copy of this announcement is shown in Appendix A.

A brochure with further details of the conference was mailed to over 100 engineers in December 1980 and an additional 100 copies were distributed at the AIAA Aerospace Sciences

Meeting in January 1981. A copy of the brochure is given as Appendix B.

3. ATTENDANCE

A total of 98 people registered for the conference, with the additional casual attendance of approximately 50 NASA/Ames employes, including the Director, Mr. C. A. Syvertson. A list of the registered attendees is given in Appendix C.

4. PROCEEDINGS

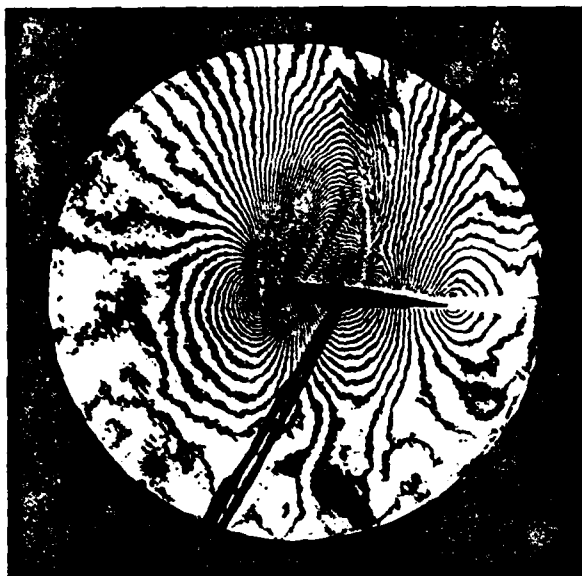
The conference proceedings will be published by AIAA as part of their "Progress in Astronautics and Aeronautics" series (series editor Dr. Martin Summerfield). The expected publishing date is March 1982. A list of presented papers is given in Appendix D. It should be noted that two papers from the section on prediction methods, those by P. A. Aidala, Grumman Aerospace Corporation, and Michael W. George of Northrop Corporation were withdrawn from the proceedings due to the pressure of company work. In addition, A. Jameson of Princeton University felt unable to submit a written copy of his paper. Since this latter paper is important to the overall balance of the proceedings, a review paper based on Jameson's vugraphs, has been written by Dr. Nixon of Nielsen Engineering & Research, Inc. Dr. Nixon has also prepared for the proceedings a summary of the panel discussion which ended the conference.

5. CONCLUDING REMARKS

The conference was very successful and a considerable amount of information was exchanged. A detailed consideration of the technical aspects of the conference will be given in the proceedings which will be mailed to ONR when available. In Appendix E, press reports of the conference by NASA personnel are given.

APPENDIX A

PRELIMINARY ANNOUNCEMENT



Transonic Perspective

**A Critique of
Transonic Flow Research**

FEBRUARY 18-20, 1981

**NASA/AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA**

PURPOSE:

- ☐ In the last decade there has been immense progress in transonic flow research, both in prediction methods and experimental techniques. However, it is sometimes suggested that the research worker often works in his own special sub-topic without being sufficiently aware of advances in other areas or of the needs of the aircraft industry. "Transonic Perspective" will gather together leading experts in the subject to discuss the state of the art of transonic flow research as a whole, and particularly in relation to the needs of industry.

ORGANIZATION AND SCOPE:

- ☐ Nielsen Engineering & Research, Inc. is organizing the symposium in conjunction with the Aerodynamics Division of NASA/Ames Research Center and the Fluid Dynamics Program of the Office of Naval Research.
- ☐ "Transonic Perspective" will consist of a series of review lectures on topics pertinent to the aircraft industry. Each lecture will be given by a leading expert in the subject. These reviews will be followed by a series of invited talks by members of industry on the general topic "Prediction Methods — Successes and Failures." It is anticipated that the presentations will stimulate invigorating, constructive discussion from both the speakers and the attendees of the symposium. The symposium will conclude with a panel discussion, which will relate the overall state of the art of transonic flow research to present and future needs of the aircraft industry, and to suggest possible future areas of research. The proceedings will be published in book form.

(SEE OTHER SIDE FOR DETAILS)

SPEAKERS AND PROVISIONAL TOPICS:

Jack N. Nielsen	— Introductory Remarks
(Nielsen Engineering & Research, Inc.)	
John R. Spreiter	— Transonics: History and Statement of the Problem
(Stanford University)	
Doris K. Steckel	— Practical Airplane Problems (Commercial)
(Douglas Aircraft Co., Long Beach)	
Richard G. Bradley	— Practical Airplane Problems (Military)
(General Dynamics)	
James A. Blackwell	— Experimental Techniques
(Lockheed-Georgia)	
Antony Jameson	— Numerical Prediction Methods — Potential Flow
(Princeton University)	
Harvard Lomax	— Numerical Prediction Methods — Navier-Stokes Equations
(NASA/Ames Research Center)	
Manuel E. Lores	— Design Techniques
(Lockheed-Georgia)	
Design Engineers	— Prediction Methods — Successes and Failures
from All Major Aircraft Companies	

A brochure giving further details of "Transonic Perspective" and information on registration and accommodations will be available around December 1, 1980. Requests for the brochure and related inquiries should be directed to the symposium coordinator:

Dr. David Nixon
Nielsen Engineering & Research, Inc.
510 Clyde Avenue, Mountain View, CA 94043
Telephone (415) 968-9457

TRANSONIC PERSPECTIVE

**A Critique of
Transonic Flow Research**

February 18-20, 1981
Moffett Field
California

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APPENDIX B

BROCHURE

TRANSONIC PERSPECTIVE

A Critique of Transonic Flow Research



February 18-20, 1981
at
NASA/Ames Research Center
Moffett Field, CA 94035

Transonic Perspective is being organized by Nielsen Engineering & Research, Inc. in conjunction with the Aerodynamics Research Branch of NASA/Ames Research Center and the Fluid Dynamics Program of

the Office of Naval Research. The objective is to gather together leading experts in the subject to discuss the status of transonic flow research as a whole, and particularly in relation to the needs of industry.

SCOPE

"Transonic Perspective" will consist of a series of review lectures on topics pertinent to the aircraft industry. These reviews will be followed by a series of invited talks by members of industry on the general topic "Prediction Methods — Successes and Failures." In addition, there will be a series of short presentations concerning alternative, or potentially alternative, methods of predicting transonic flow phenomena. The symposium will conclude with a general discussion, to stimulate invigorating, constructive interchanges from both the members of a panel and the attendees of the symposium. This discussion will relate the overall state of the art of transonic flow research to present and future needs of the aircraft industry, and will suggest possible future areas of research. The proceedings will be edited and published as one of the series "Progress in Astronautics and Aeronautics."

CALL FOR PAPERS ON "ALTERNATIVE PREDICTION METHODS"

The symposium covers two types of prediction methods, namely the numerical solution of the potential equation and the Navier-Stokes equations. While these types of solutions constitute the main thrust of present research in numerical prediction methods, it is fair to say that alternative or potentially alternative methods may be available. Consequently, there will be a session entitled "Alternative Prediction Methods" consisting of four twenty-minute presentations concerned with hybrid or innovative methods for predicting transonic flow characteristics. Authors who wish to present such techniques should send an abstract of approximately 1,000 words to:

Dr. David Nixon
Nielsen Engineering & Research, Inc.
510 Clyde Avenue, Mountain View, CA 94043

Abstracts are due no later than January 10, 1981. Authors will be notified of acceptance of their papers by January 24, 1981.

LOCATION

"Transonic Perspective" will be held in the Main Auditorium (Building 201) at NASA/Ames Research Center, Moffett Field, CA. Moffett Field is located beside U.S. Highway 101 near Mountain View, and is 25 miles south of the San Francisco International Airport and 10 miles north of the San Jose Airport.

ACCOMMODATIONS

A block of rooms has been reserved at Hyatt Richeys, 4219 El Camino Real, Palo Alto, CA 94306, at a reduced price of \$50.00 per person for a single room, \$65 for a double room, plus tax. This block of rooms will be held until January 15, 1981; after this date the rooms will be released to the general public. Please use the enclosed card to make your reservations directly with Hyatt Richeys; this will ensure access to the reduced rates.

REGISTRATION

Registration for the symposium will take place at the Regency Suite, Hyatt Richeys at 4219 El Camino Real, Palo Alto, between 7:00 p.m. and 10:00 p.m. on Tuesday, February 17 and between 7:00 a.m. and 8:30 a.m. on Wednesday, February 18. The conference badge is sufficient identification to obtain a vehicle pass at the Security Station near Gate 18 of Ames Research Center (see map). Registration for Ames employees or authorized contractors will also be possible at the Main Auditorium.

Foreign nationals who are not permanent residents of the U.S. should provide the relevant information on the registration form and must register by February 11, 1981. Foreign nationals who reside outside the U.S. should note that special permission is required to enter Ames Research Center. Information on this may be obtained from NASA Headquarters, Washington, D.C. 20546.

SOCIAL EVENTS

Banquet

A banquet will be held at Maddalena's Continental Restaurant, 544 Emerson Street, Palo Alto, at 7:30 p.m., Wednesday, February 18. The cost of the banquet is included in the registration fee; additional tickets may be purchased at the Symposium.

Lunch

Lunch will be provided at the Ames Research Center Cafeteria on Wednesday, February 18 and Friday, February 20. A special lunch will be held at 11:30 a.m. on Thursday, February 19, at the Commissioned Officers Club at Moffett Field. The cost of all lunches is included in the registration fee.

Reception

A Reception will be held on Thursday evening at Hyatt Richeys at 6:30 p.m.

INFORMATION DESK

There will be an information desk outside the Main Auditorium throughout the meeting. Telephone messages can be received at the information desk; the telephone number is (415) 965-5256.

PARKING

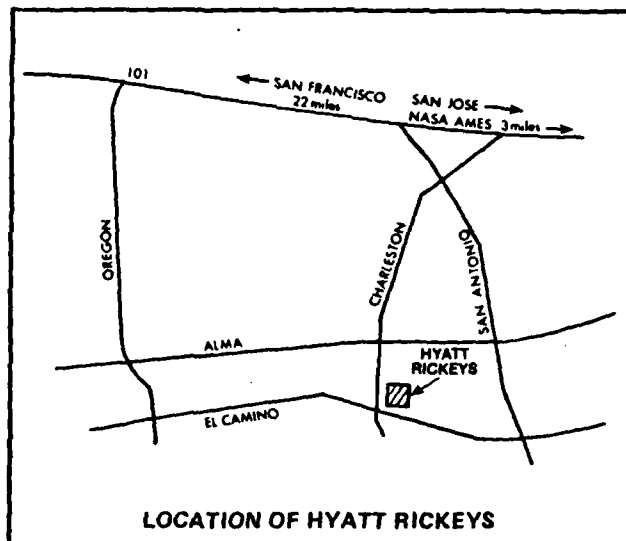
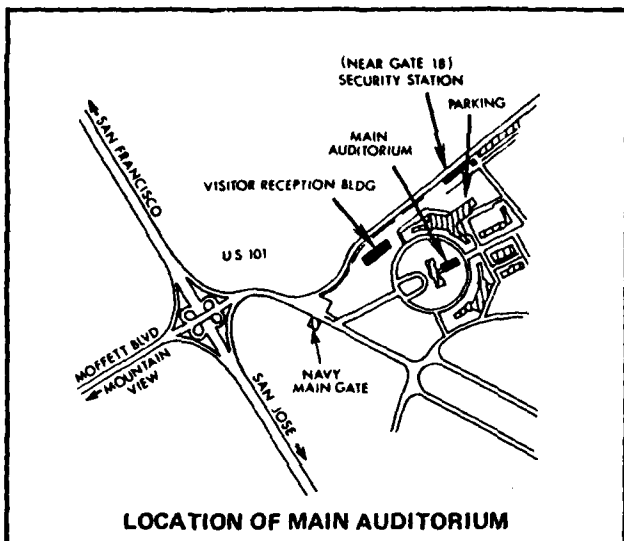
Cars should be parked at the parking lot behind the Security Station. This area is indicated on the map.

REGISTRATION FEE

The registration fee is \$160.00 and includes the cost of preprints of the review papers, lunches, refreshments, banquet, and the final, edited version of the proceedings of the symposium. Advance registration is encouraged and for those registering before January 23, 1981 the fee is \$145.00.

Checks and money orders should be made payable to "Transonic Perspective" and this and any other communications or inquiry should be addressed to David Nixon or Bonnie Thomas at:

Nielsen Engineering & Research, Inc.
510 Clyde Avenue, Mountain View, CA 94043
Telephone: (415) 968-9457



TRANSONIC PERSPECTIVE

February 18-20, 1981
NASA/Ames Research Center
Moffett Field, CA 94035

REGISTRATION FORM

(Duplicates of this form are acceptable)

Name: _____ Title: _____

Affiliation: _____

Professional Address: _____

Telephone Number: () _____

Check here if you will require transportation between Hyatt Rickeys and NASA/Ames Research Center:

☐ YES ☐ NO

TECHNICAL PROGRAM

Wednesday, February 18

- 8:45 a.m. *Introductory Remarks* — Jack N. Nielsen, President, Nielsen Engineering & Research, Inc.
- 9:15 a.m. *Transonics — History and Statement of the Problem* — John R. Spreiter, Professor of Applied Mechanics, Stanford University
- 10:30 a.m. Coffee Break
- 11:00 a.m. *Practical Airplane Problems (Commercial)* — Frank T. Lynch, Branch Chief, Aerodynamics R&D Program, McDonnell Douglas Corporation
- 12:15 p.m. Lunch — Ames Cafeteria
- 1:45 p.m. *Practical Airplane Problems (Military)* — Richard G. Bradley, Engineering Chief, Aeroanalysis, General Dynamics Corporation
- 3:00 p.m. *Experimental Techniques* — James A. Blackwell, Staff Aerodynamicist, Lockheed-Georgia Company
- 4:00 p.m. Coffee Break
- 4:30 p.m. *Numerical Prediction Methods (Potential Flow)* — Antony Jameson, Professor, Dept. of Aerospace Engineering, Princeton University
- 5:45 p.m. Close
- 7:30 p.m. Banquet — Maddalena's Continental Restaurant

Thursday, February 19

- 8:30 a.m. *Numerical Prediction Methods (Navier-Stokes Equations)* — Harvard Lomax, Chief, Unmeel Mehta, Research Scientist, Computational Fluid Dynamics Branch, NASA/Ames Research Center
- 9:40 a.m. Coffee Break
- 10:10 a.m. *Design Techniques* — Manuel E. Lores, Senior Scientist, Systems Engineering, Lockheed-Georgia Company
- 11:30 a.m. Lunch — Commissioned Officers Club, Moffett Field
- 1:30 p.m. *Alternative Prediction Methods* — Richard W. Barnwell (Chairman), Research Scientist, NASA/Langley Research Center
- 3:00 p.m. Coffee Break
- 3:30 p.m. *Prediction Methods — Successes and Failures*
Grumman Aerospace Corporation, Paul Aldala
Northrop Corporation, Michael W. George
- 4:15 p.m. Close
- 5:00 p.m. Close
- 6:30 p.m. Reception — Hyatt Riskey

Friday, February 20

- 8:30 a.m. *Prediction Methods — Successes and Failures*
General Dynamics Corporation, Ishwar C. Bhateley
- 9:15 a.m. Lockheed-Georgia Company, H. Patrick Haney (This talk will concern the Vought A-7 Airplane)
- 10:00 a.m. Coffee Break
- 10:30 a.m. Rockwell International (North American Aircraft Div.), Elwood Bonner
- 11:15 a.m. McDonnell Douglas Corporation (St. Louis), August Verhoff
- 12:00 p.m. Lunch — Ames Cafeteria
- 1:15 p.m. Gates Learjet Corporation, Michael L. Hinson
- 2:00 p.m. McDonnell Douglas Corporation (Long Beach), Preston A. Henne
- 2:45 p.m. Lockheed-California Company, Luis R. Miranda
- 3:30 p.m. Coffee Break
- 4:00 p.m. Discussion Panel
P. J. Bobbitt, NASA/Langley Research Center (Chairman)
Richard W. Barnwell, NASA/Langley Research Center
James A. Blackwell, Lockheed-Georgia Company
Richard G. Bradley, General Dynamics Corporation
Antony Jameson, Princeton University
- Unmeel Mehta, NASA/Ames Research Center
Robert E. Melnik, Grumman Aerospace Corporation
Doris K. Steckel, McDonnell Douglas Corporation
Hideo Yoshihara, Boeing Commercial Airplane Co.
- 5:30 p.m. Close

Registration Fee (Includes preprints of review papers, banquet, lunches, refreshments and a copy of the final version of the symposium proceedings):

Pre-register by January 23, 1981 — \$145
Register after January 23, 1981 — \$160

Make your check or money order payable to "Transonic Perspective."

If not a U.S. Citizen or Permanent Resident, please give the following information:

Nationality: _____ Expiration Date of Visa: _____

NOTE: Those who are not U.S. Citizens or Permanent Residents must register by February 11, 1981:

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APPENDIX D

LIST OF PAPERS AND SPEAKERS

LIST OF PAPERS AND SPEAKERS

TRANSONICS - HISTORY AND STATEMENT OF THE PROBLEM

John R. Spreiter, Stanford Univeristy

PRACTICAL AIRPLANE PROBLEMS (COMMERCIAL)

Frank T. Lynch, McDonnell Douglas Corporation

PRACTICAL AIRPLANE PROBLEMS (MILITARY)

Richard G. Bradley, General Dynamics Corporation

EXPERIMENTAL TECHNIQUES

James A. Blackwell, Lockheed-Georgia Company

NUMERICAL PREDICTION METHODS (POTENTIAL FLOW)

Antony Jameson, Princeton Univeristy

NUMERICAL PREDICTION METHODS (NAVIER-STOKES EQUATIONS)

Harvard Lomax, NASA/Ames Research Center

DESIGN TECHNIQUES

Manuel Lores, Lockheed-Georgia Company

NONLINEAR GREENS FUNCTION METHOD FOR UNSTEADY TRANSONIC FLOWS

Luigi Morino and Kadin Tseng, Boston University

A HYBRID APPROACH TO TRANSONIC INVISCID FLOW WITH MODERATE
AND STRONG SHOCK WAVES.

Tsze C. Tai, David W. Taylor Naval Ship Research and Development
Center

TRANSONIC SHOCK-TURBULENT BOUNDARY LAYER INTERACTION AND
INCIPIENT SEPARATION ON CURVED SURFACES

George R. Inger, University of Colorado

THE RAPID APPROXIMATE DETERMINATION OF NONLINEAR SOLUTIONS:
APPLICATION TO AERODYNAMIC FLOWS AND DESIGN/OPTIMIZATION
PROBLEMS

Stephen S. Stahara, Nielsen Engineering & Research, Inc.

PREDICTION METHODS - SUCCESSES AND FAILURES

Paul Aidala, Grumman Aerospace Corporation

Michael W. George, Northrop Corporation

Ishwar C. Bhateley, General Dynamics

H. Patrick Haney, Lockheed-Georgia Company

Elwood Bonner, Rockwell International (North American Aircraft Division)

August Verhoff, McDonnell Douglas Corporation (St. Louis)

Michael L. Hinson, Gates Learjet Corporation

Preston A. Henne, McDonnell Douglas Corporation (Long Beach)

Luis R. Miranda, Lockheed-California Company

APPENDIX E

PRESS REPORTS ON "TRANSONIC PERSPECTIVE"

Copy of Report from "Computational Fluid
Dynamics Activities" Published by
NASA Headquarters

TRANSONIC PERSPECTIVE WORK SHOP

The Transonic Perspective Workshop was held at Ames Research Center, February 18-20, 1981 and was a series of selected lectures on topics pertinent to the aircraft industry. The topics covered included reviews of CFD and experimental methodology, short lectures on viable alternatives for predicting transonic flow phenomena, and comments on the successes and failures of predictive methods. The workshop was concluded by an interchange between members of a select panel and attendees.

Several important results that could be gleaned from the consensus opinion were that the lift/drag ratio, one of the most important aircraft design parameters, cannot be adequately predicted by either CFD or wing-tunnel experiments. It was also suggested that even relative drag coefficients are not always reliably predicted. The use of numerical optimization has numerous pitfalls; the most effective users invariably override the process with intelligence based on experience and intuition. However, these techniques are considered important and further development of improved procedures was encouraged.

Also, the use of numerical methodology in aircraft design is clearly on the upswing. Such use has already resulted in a reduction of wing-tunnel requirements (with fewer models in achieving aircraft design goals. Development of robust and easy to use application codes was encouraged.

The conference proceedings will be published by the AIAA as part of the series "Progress in Astronautics and Aeronautics."

Copy of Report from "CFD" Published by
NASA/Ames Research Center

TRANSONIC PERSPECTIVE - A CRITIQUE OF
TRANSONIC FLOW RESEARCH

"Transonic Perspective," which was held at Ames Research Center, February 18-29, 1981, was a series of selected lectures on topics particularly pertinent to the aircraft industry. The topics covered were reviews on CFD and experimental methodology on aircraft problems, comments on the general topic "Prediction Methods--Success and Failures," and short lectures on viable alternative methods for predicting transonic flow phenomena. The symposium concluded with an invigorating and constructive interchange between members of a selected panel and the attendees of the symposium. The papers were of an exceedingly high quality as were the discussions which were frequently very constructively stimulated by the wit of the symposium chairman Dr. Dave Nixon of Nielsen Engineering & Research, Inc.

Several important conclusions that could be gleaned from the symposium were that the lift/drag ratio, the most important aerodynamic parameter for an aircraft designer, cannot be adequately predicted either by use of numerical methods or by use of wind-tunnel experiments. It was also suggested that even relative drag coefficients are not always reliably predicted. The use of numerical optimization has numerous pitfalls; the most effective users invariably override the process with intelligence based on experience and intuition (this is not yet a field for the novice). The techniques are considered important, however, and the development of improved procedures is encouraged. Also, the effective use of numerical methodology in aircraft design is clearly on the

upswing. Such use has already resulted in a reduction of wind-tunnel test requirements (with fewer models) in achieving aircraft design goals. Numerical programs do require sophisticated users; development of robust and easy to use codes is encouraged.

The full account of the conference will be published in the American Institute of Aeronautics and Astronautics (AIAA) series "Progress in Astronautics and Aeronautics."

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